Neurocentral synchondrosis (NCS) is a physis in the spine located at the junction of the pedicle and vertebral body. It contributes to one third of the growth of the vertebral body and one third of the growth of the posterior arch. In humans, the role played by the NCS in scoliosis is still unknown. Some authors have suggested that asymmetrical growth of the vertebral arches at the NCS could produce rotational deformity and lateral curvature of the vertebral column. The objectives of this prospective study were: 1) to determine whether there is asymmetry of the NCS in patients with infantile (IIS) and juvenile idiopathic scoliosis (JIS); 2) to determine if there is a correlation between the asymmetry of the NCS and the morphology of the vertebra that are part of the scoliotic deformity; and 3) to determine if there is a correlation between the asymmetry of the NCS and the degree of spinal curvature.

Materials and Methods
Following approval from the Institutional Review Board, true axial MRI images were obtained in the thoracic and lumbar vertebrae of 15 patients who had IIS and JIS. The axial images were acquired to ensure they were symmetric to both pedicles, and parallel to the superior endplate of the vertebra. The images for the vertebrae in the major curve were digitally analyzed for the following parameters:

1) NCS developmental stages: The developmental stages of the concave and convex NCS of each vertebra were assessed using a custom 6-point scale: 0: NCS appears as a thick, low-intensity black line that is continuous, suggesting it is open and has 0% closure (Figure 1A, single arrow); 1: < 25% NCS closure; 2: 25-49% NCS closure; 3: 50-74% NCS closure; 4: 75-99% NCS closure; and 5: 100% NCS closure (Figure 1A, double arrows).

2) The NCS width and thickness were measured on the concave (W and T) and convex (W1 and T1) side of each vertebra (Figure 1B).

3) The pedicle length was the distance from the center of the neurocentral joint, through the axis of the pedicle to the margin of posterior arch. The pedicle width was the distance between the two cortical bone margins in the center level of the pedicle axis. The anterior-posterior (AP) length was the distance from the anterior margin of vertebral body, through the axis of the pedicle to the margin of posterior arch. The pedicle morphology was measured on concave (BP, DE, AP) and convex (B1P1, D1E1, A1P1) side of each vertebra (Figure 2).

Results
There were 12 females and 3 males with an average age of 5.8 years (0.8 to 10 years). The average curve magnitude was 40.1º (14º to 70º) with 11 thoracic and 4 TL/L curves and the average apical vertebral rotation was 17.2º. The concave NCS morphology was 29% wider and 23% thicker than the convexity (P<0.05). The convex NCS closure rate was 34% greater than the concavity (P<0.05) at apical vertebrae (Table 1). The concave pedicle length and anterior-posterior length was 9% and 8% greater than the convexity, respectively (P<0.05). The concave pedicle width was 11% greater than the convexity at apex (P<0.05) (Table 2). There was a positive correlation between the NCS width and the pedicle length at the apical/periaxial vertebrae (P<0.05). The increased NCS and pedicle morphology on the concavity correlated with vertebral axial rotation (P<0.05).

Discussion
Developmental asymmetry of the NCS, pedicle and vertebral body was seen in IIS and JIS patients. The concave NCS, pedicle and vertebral body had greater growth when compared to the convexity and were associated with greater vertebral axial rotation. The NCS may play a role in the development or progression of idiopathic scoliosis in these young patients. Growth inhibition of the concave NCS may be a strategy for surgical treatment of early onset scoliosis.

Reference